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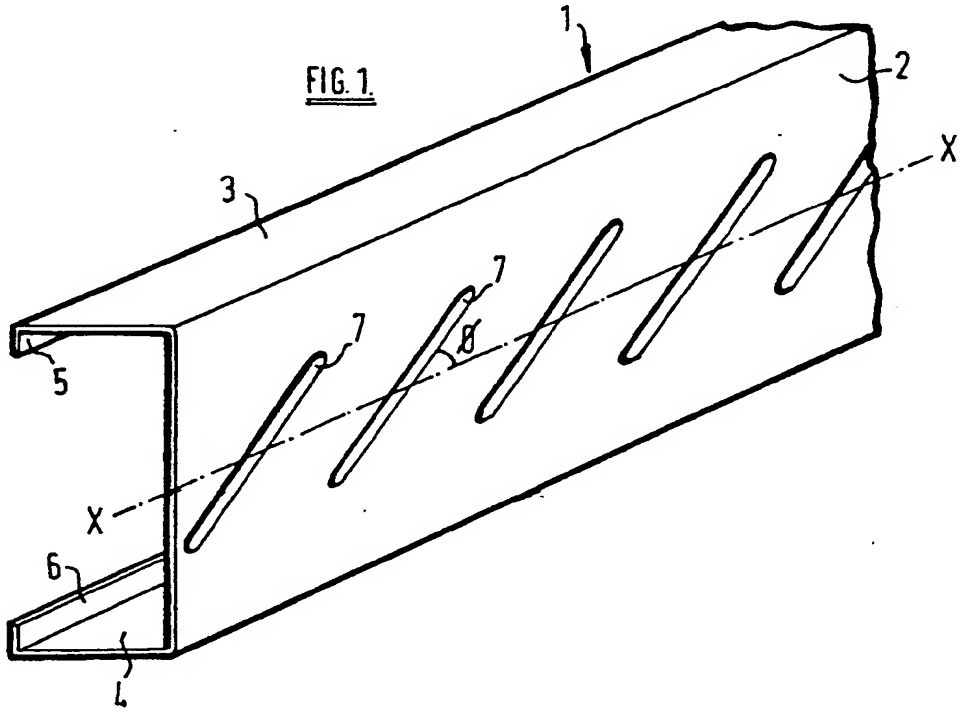
(54) Improvements in structural members

(57) The present invention discloses a structural framework member having a channel cross-section and in which the web element 2 is formed to include one or more series of rib formations 7, extending at an angle of 45° to the longitudinal axis of the web, the length of the ribs being such at from 15 to 30% of the width of the web at each side of a rib has a planar surface. The ribs may extend as a series of parallel grooves, as two series of parallel grooves providing a herring-bone formation or two series of intersecting parallel grooves each series extending in opposite directions to provide an X-formation. Two elements may be secured together in a back-to-back arrangement to form an I-beam.

FIG. 1.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

...ed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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FIG. 1.

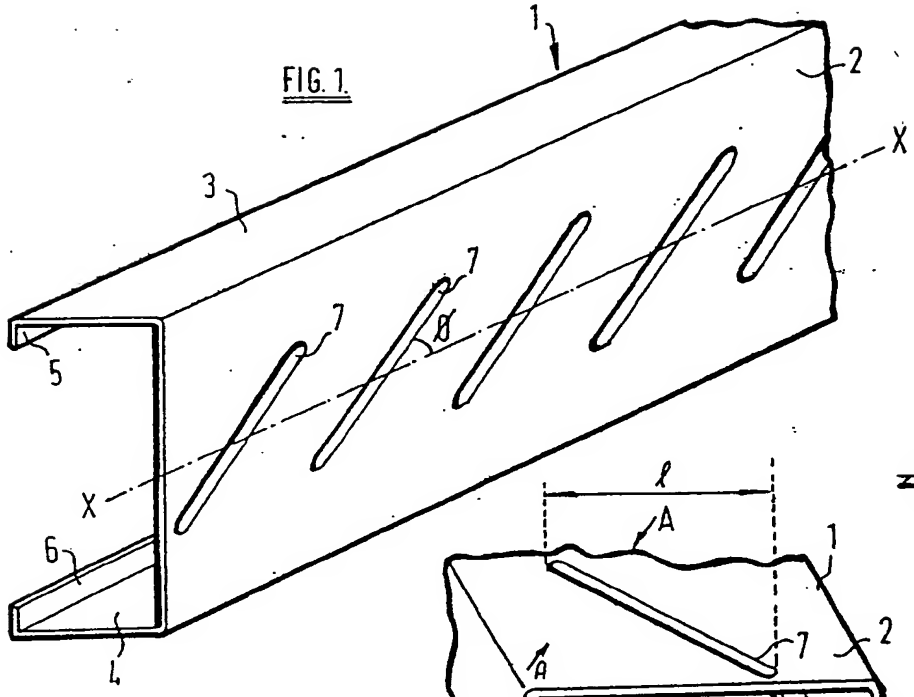

FIG. 2.

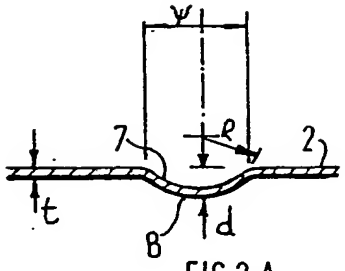

FIG. 2 A.

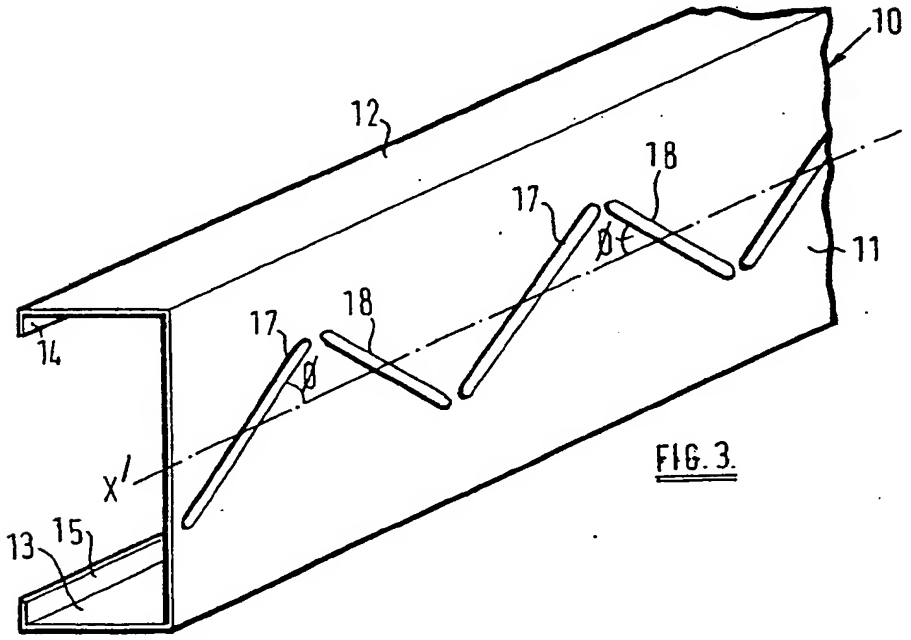

FIG. 3.

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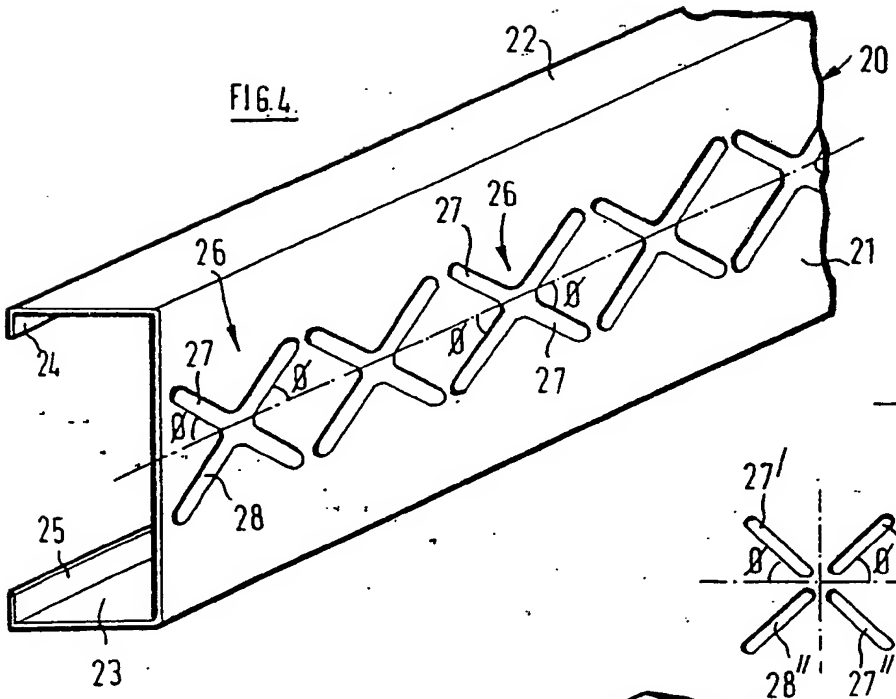
FIG.4.



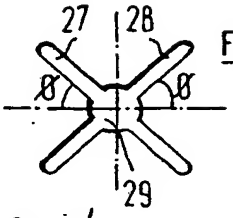


FIG.4A.

FIG.4.B.

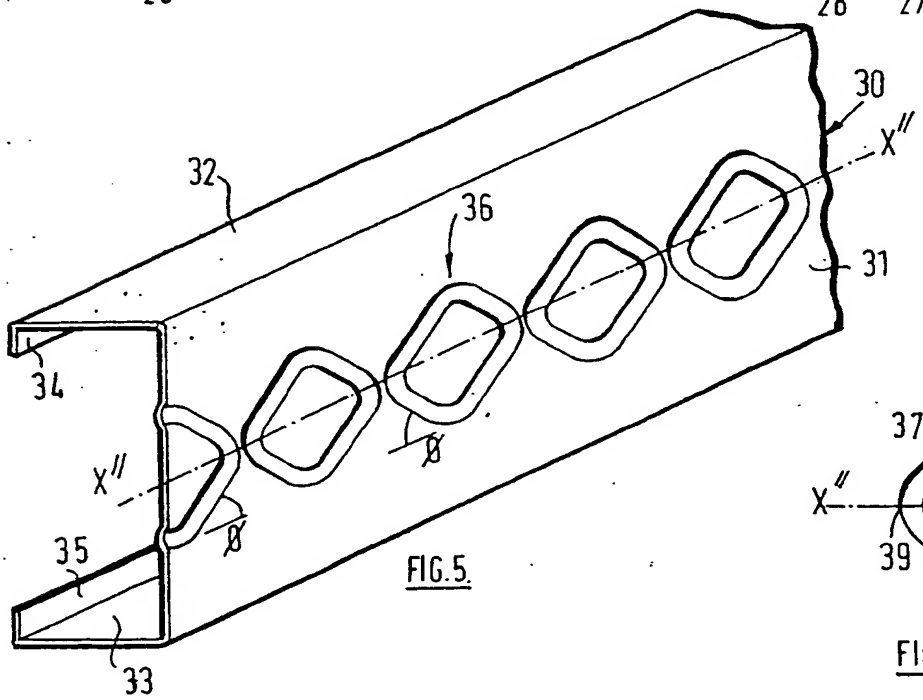


FIG.5.

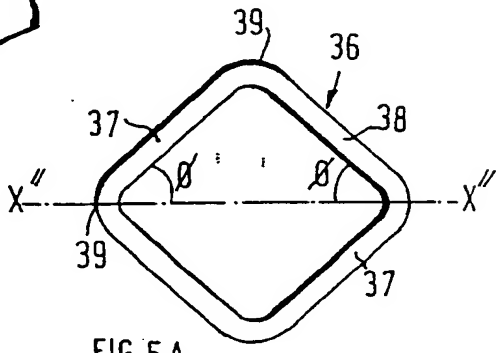


FIG.5A.

SPECIFICATION

Improvements in structural members

The present invention relates to improvements in structural framework members particularly such members having an essentially channel or open E-shaped cross-section comprising a web (base) and two side walls extending, preferably at right angles, therefrom, the side walls also preferably presenting an inwardly turned lip formed substantially parallel to the base.

Structural framework members find a wide variety of uses especially in metal framed buildings, mezzazine floors, storage platforms and purlins to support roof structures. However, uneven loading of such members, especially when used as vertical or horizontal supports, imparts stress on the members especially torsional stresses which result in the members twisting about their longitudinal axes. Thus such members, especially when required as vertical support members, are frequently used in pairs and are secured in a back-to-back arrangement to produce a form of I-beam structure or face-to-face to produce a box structure.

In order to reduce the deformation of the members resulting from applied stress, it has been proposed, for example as described in PCT application publication No. 83/03811, to swage grooves into the webs of such members, the grooves extending longitudinally and for the whole length thereof. However, such grooves are not wholly effective in preventing distortion resulting from applied torsional stresses.

I have now provided a structural member that has improved resistance to stress distortion, e.g. torsional stress distortion and to buckling of the thin walled web.

From one aspect, therefore, my invention provides a structural member having an open E-section comprising a web and side wall elements, wherein a plurality of ribs of lengths greater than width are formed in the web, the ribs being formed with their lengthwise axes at an angle to the longitudinal axis of the member.

The ribs may conveniently be formed by known pressing or rolling techniques and may project "inwardly" or "outwardly" of the web i.e., lie within the channel section or project outwardly thereof.

The ribs are preferably formed at 45° to the longitudinal axis of the member and are most preferably equi-spaced along the whole length of the said member.

The ribs may, for example, be formed as a series of parallel formations each extending in the same direction; as two series of formations extending alternately in opposed directions each series of ribs being parallel to produce a herringbone formation; as a series of intersecting opposed ribs, the ribs in each section being parallel to provide an X-rib formation; or as a series of rounded corner box formations. More than one series of any of the above formations may be formed in the web of any particular member. It is preferably that the ribs in each series are all of the same dimensions.

Embodiments of the invention will now be described with reference to the accompanying diagrammatic representations in which:

Fig. 1 is an isometric view from the rear of one embodiment of the invention;

Fig. 2 is an isometric view of the embodiment of Fig.1 from one end;

Fig. 2a is a section through A-A of Fig. 2;

Fig. 3 is an isometric view from the rear of a second embodiment;

Fig. 4 is an isometric view from the rear of a third embodiment;

Fig. 4a is a detail of a variation of the rib formation of Fig. 4;

Fig. 4b is a detail of a second variation of the rib formation of Fig. 4;

Fig. 5 is an isometric view from the rear of a fourth embodiment;

Fig. 5a is a detail of the rib formation of Fig. 5.

Peferring to Figs. 1 and 2 of the drawings, a structural member generally indicated at 1 consists of a web portion 2, ide wall portions 3 and 4 and inwardly turned lips 5 and 6, A series f elongate grooves or ribs 7 are formed in the web portion 2 at an angle ϕ to the longitudinal axis X-X of the member. The lowermost portion 8 of grooves 7 lie within the open E-section shape of the ember.

The beam may be of any desired length; other specific dimensions, by way of example only, may be as follows;

web width (external) : 220 mm
wall height (external) : 63.5 mm
lip width (external) : 13 mm

Grooves 7 are spaced 100 mm apart (centered to centre) at an angle ϕ = 45°, have a maximum width W, of 35 mm, a depth d of 5 mm and an overall length l of 143 mm.

The beam 1 is rolled from a sheet or coil of material of the required length having a width of 385 mm and a thickness of 2 mm.

In general-:

Angle ϕ is in the range $>0°$ to $<90°$

W = less than 40 mm and is less than 2 R where R is the radius of a circle defining groove 7,

The depth of the groove d is less than 3t where t is the material thickness; and

l is less than the width dimension of web 2 (?)

Length l and angle ϕ being such that from 15—30% of the width of the web, measured from either end of the groove to the adjacent side wall is face from grooving.

The material thickness is preferably in the range 1.5 mm to 2.5 mm.

A second embodiment of the invention is shown in Fig. 3 in which the member generally indicated at 10 consists of a web 11 side walls 12 and 13 and lip portions 14 and 15. A series of grooves 17,18 are formed along the length of the structure, alternate grooves being in opposed directions to provide a herringbone type of formation. Grooves 17 and 18 are of substantially identical dimensions and are formed with their major axes at equal angles ϕ to the longtudinal axis X'—X'. The dimensions of the beams are substantially the same as those in Figs. 1 and 2 and as, previously indicated, the dimensions of the grooves 17 and 18 are also substantially the same for Figs. 1 and 2, except that the distance apart of grooves 17 is now 200 mm with grooves 18 also being 200 mm apart.

A fourth embodiment of the invention is shown in Figs. 4, 4a and 4b. The member generally indicated at 20, has a web 21, walls 22 and 23 and inwardly directed lips 24 and 25. A series of X-shaped groove formations generally indicated at 26, consist of crossed elements 27 and 28, each element having substantially the same dimensions as grooves 7 of Fig. 1. Grooves 27 and 28 are angled, angle ϕ equals 45°, to the longitudinal axis of the beam.

Fig. 4a shows an alternative form of groove formation 26 in which the centre of the formation, 29, is cusp shaped.

A further formation in variation 26 is shown in Fig. 4b in which the X-shape is achieved by forming 4 grooves 27', 27" 28' and 28" with the adjacent end portions of the grooves just failing to join together.

A fifth embodiment of the invention is shown in Figs. 5 and 5a in which a member generally indicated at 30, comprises a web 31, wall portions 32: 33 and inwardly directed lips 34 and 35. A series of groove formations 36, are formed as box structures consisting, essentially, of two lines of grooves 37 formed parallel to each other and lying on opposite sides of the longtiudinal axis X"-X" joined by a second two lines of grooves 38,38' also lying on opposite sides of the longitudinal axis of the member. The ends of the grooves 37,38,37',38' being respectively joined to provide box structure 36 with rounded corners 39. Again the angle of each line of grooves to the longitudinal axis is ϕ = 45°.

The effect of producing the groove formations in the web in which the material for the groove is drawn from the flat area into the groove creates improved rigidity and increases the yield strength of the material locally in the area subjected to the work operation. The latter: together with the form of the grooves and their angular position relative to the longitudinal axis of the member improves the stability of the thin walled web even under loaded conditions, the member being especially resistant to tortional stress distortion.

As previously stated the groove may project inwardly or outwardly of the web 31, where two members are required to be secured in a backto-back arrangement to form an I-beam, the projection of the grooves in the members may be arranged to be complimentary such that they project outwardly from one member to engage in the corresponding inwardly directed grooves in the other member, thereby providing a further significant increase in resistance to distortion.

The grooves may be formed in the webs by a swaging technique in which one roller contains protrusions on the surface thereof to impress into the web grooves of appropriate dimensions, one roller having side shoulders which extend outwardly from the ends of the grooves and have a height equivalent to the depth of the grooves. Alternatively, of course, the roller may have co-operating male and female portions to form the grooves in the web.

The grooves may be pressed into the material after rolling. Preferably, however, the grooves are impressed before or during rolling, the rolling action of the profile being accommodated outside the groove area.

CLAIMS

1. A structural member comprising an element having an open section and consisting of a web and two opposite side wall elements, wherein a plurality of ribs of lengths greater than their widths are formed in the web, the ribs extending with their lengthwise axes at an angle to the longitudinal axis of the web.

2. A structural member according to claim 1 wherein the ribs formed in the web of the element project inwardly of the web or all ribs project outwardly of the web.

3. A structural member according to claim 1 or claim 2 wherein the ribs are formed at an angle of 45° to the longitudinal axis of the element.

4. A structure according to any one of claims 1 to 3 wherein the ribs are in the form of a series of parallel formations each extending in the same direction.

5. A structure according to any one of claims 1 to 3 wherein the ribs are formed as two series of formations extending alternately in opposed directions, the ribs in each formation being parallel to each other to produce a herring-bone formation.

6. A structural element according to any one of claims 1 to 3 wherein the ribs are in the form of two series of intersecting ribs extending in opposite directions, the ribs in each series being parallel to provide a series of 'X' formations.

7. A structural member according to any one of claims 1 to 3 wherein the ribs provide a series of rounded corner box formations, the

ribs forming the opposing sides of each box formation being parallel to each other and to corresponding ribs adjacent the box.

8. A structural member according to any one of the preceding claims wherein the ribs are in the form of grooves having a width of less than twice the radius of a circle defining the groove.

9. A structural member according to any one of the preceding claims wherein the length of each rib is less than the width dimension of the said web.

10. A structural member according to any of the preceding claims wherein the depth of the ribs is less than 3 times the thickness of the material forming the element.

11. A structural member according to any one of the preceding claims wherein the length of the ribs and the angle of the ribs to the longitudinal axis of the element is arranged to provide from 15 to 30% of the width of the web measured from either end of a rib to the nearest adjacent side wall and does not include any rib formations.

12. A structural member according to claim 1 and including two open S-shaped elements including rib formations as claimed in any one of claims 2 to 11 said elements being secured together in a back-to-back arrangement to provide an I section beam.

13. A structural member according to claim 12 wherein the rib formation in one element projects inwardly thereof and the rib formation in the second element project outwardly of the web, the rib formations in the webs of each element being arranged to provide for co-operation therebetween.

14. A structural member substantially as herein described with reference to Figures 1 to 5 of the drawings.

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